Case Reports

Magnetic Resonance Imaging of Cysticercosis

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THE DIAGNOSIS OF CEREBRAL CYSTICERCOSIS is often quite challenging[1] both clinically and radiographically. Until recently, computed tomography (CT) was undoubtedly the imaging modality of choice for detecting these lesions. In this report, we describe the magnetic resonance (MR) findings in two patients with biopsy-proved cysticercosis and compare the results with those of CT.

Methods

Two patients were studied with a 0.5-tesla superconductive magnetic resonance imaging device manufactured by Picker International. Scans were generated in the sagittal, coronal and transaxial planes in both patients, and both T1- and T2-weighted sequences were used. The T2-weighted sequence comprised a repetition time (TR) of 2,200 ms and an echo-delay time (TE) of 80 ms, and the T1-weighted images were obtained using a TR of 850 ms and a TE of 40 ms. CT scans were available for review and comparison on both patients. In both cases, these were done on a GE 8800 CT scanner using 1-cm slice thickness.

Reports of Cases

Case 1

A 42-year-old Bolivian physician had her first generalized seizure in 1983. CT and angiography at that time were interpreted as normal. In August 1984, subcutaneous nodules developed on the patient's scalp, oral mucosa, neck and groin. A biopsy of the scalp and oral lesions was interpreted as being consistent with cysticercosis. Additional seizures occurred in November 1984, and a CT scan at that time showed areas of edema in both the right and left parietal lobes (Figure 1). MR imaging showed these lesions and several other areas of abnormally increased signal intensity on the T2-weighted images. They were located in the left and right parietal lobes, as well as in both temporal lobes and in the left frontal lobe (Figure 2). On the T2-weighted sequences, several of the lesions had small areas of decreased signal intensity lying eccentrically within the areas of increased signal intensity. Many of these areas were spherical and were felt to represent the scolex of the worm. Evaluation of the configuration of some of the lesions shows that those that are peripherally placed generally conform to the shape of cerebral sulci. Cysticerci within the subarachnoid space of the cerebral sulcus dilate the sulcus as the cysts enlarge. This may explain the somewhat unusual configuration and dimension of the lesions seen on these scans (Figures 2 and 3). The zones of increased signal intensity were felt to represent areas of edema and cyst formation. Following the magnetic resonance imaging, the patient was placed on a regimen of praziquantel for 14 days. A repeat MR imaging approximately three weeks later showed pronounced resolution of the edematous regions within the cerebral hemispheres (Figure 4).

ABBREVIATIONS USED IN TEXT

CT = computed tomography
MR = magnetic resonance
TR = repetition time
TE = echo-delay time

Case 2

The patient, a 43-year-old man, experienced several episodes of numbness in the right arm lasting about 30 minutes. Following an episode of transient aphasia and seizures, he was admitted to hospital and a CT scan showed a rim-enhancing low-density lesion in the left frontoparietal area (Figure 5, left). Cerebral angiography revealed an avascular mass in the left parietal lobe. Results of a cerebrospinal fluid evaluation were normal. MR images showed an area of increased signal intensity in the left parietal lobe on the T2-weighted images. It was quite homogeneous in intensity on the section obtained directly through the midportion of the lesion, but a mixed pattern of signal intensity was observed just below the lesion, probably representing averaging of edema from the lesion and normal brain. Normal white matter structures were effaced, which was better seen on the coronal scan (Figure 5, middle and right).

About one week after the MR study, a posterior parietal craniotomy was done. A cystic lesion measuring approximately 2.5 cm in diameter was removed. Microscopic examination of hematoxylin-eosin-stained sections showed the typical cysticercus pattern of three characteristic layers: The outer cuticular and nuclear germinative, which comprise the tegument, and the parenchymatous reticular.

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The scolex was identified with its multiple hooks, indicating that this was a parenchymal cyst. A follow-up MR study showed reduced edema at the surgical site (not shown).

Discussion

Cysticercosis is a parasitic infection endemic to parts of Asia, India, Africa, Europe and Latin America. The causative organism is *Taenia solium,* the pork tapeworm. Humans are an intermediate host of the organism, acquiring it by accidentally ingesting tapeworm eggs from fecal-contaminated substances. The eggs hatch in the small intestine, burrow into the mucosa and then penetrate the venules. Mature larvae or cysticerci develop after 60 to 70 days.

Cerebral cysticerci may involve the brain parenchyma, ventricular system, subarachnoid space or a combination of these, which results in a variety of clinical manifestations. Symptoms usually do not appear for four to five years following infection by the organism; this latent period is related to the life span of the cysticercus. Viable cysts do not provoke an inflammatory reaction in the surrounding tissue, but dead larvae cause inflammation leading to an enlargement of the lesions and provocation of symptoms. The active cysts tend to assume the shape of the space they occupy and, therefore, may not be spherical or cylindrical when occurring in the ventricles or in the subarachnoid space. Dead cysticerci are usually partially or totally calcified spheres. When only partially calcified, there is usually a small, slightly eccentric calcification within the lesion, representing the calcified head, or scolex.

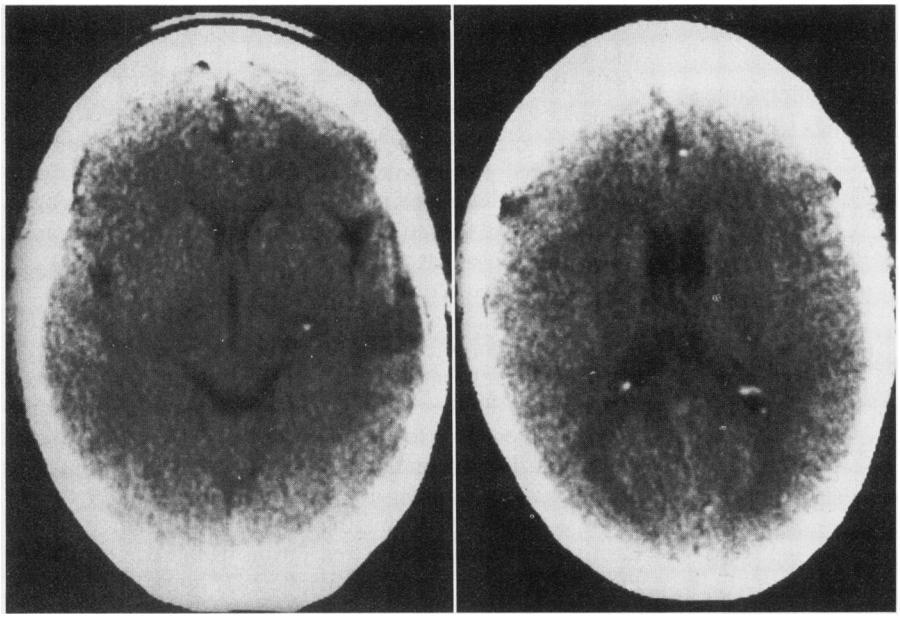

Figure 1.—Patient 1. Non-contrast computed tomographic scan showing edema in both parietal lobes **(left** and **right).** Additionally, a punctuate calcification with surrounding edema is seen in the left basal ganglia region **(left).**

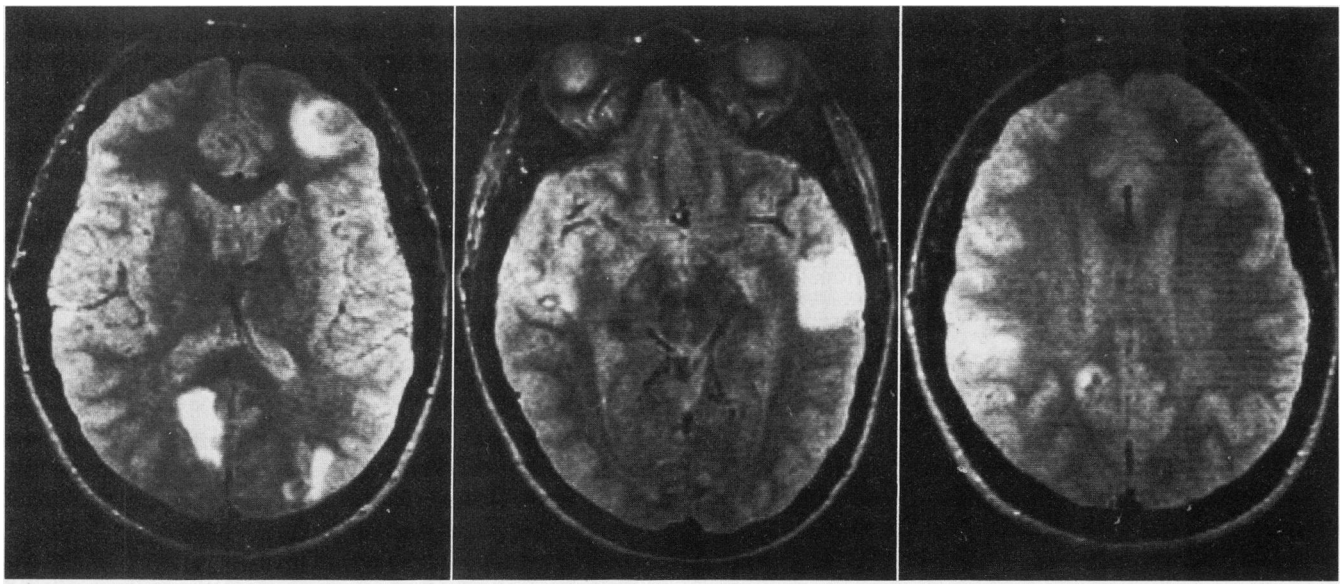

Figure 2.—Patient 1. Spin-echo magnetic resonance images (repetition time 2,000 ms, echo-delay time 80 ms) showing areas of increased intensity in the left frontal lobe **(left)** and bilaterally in the temporal **(middle)** and occipital lobes **(right).** Many more lesions are shown than with computed tomography (compare with Figure 1). Also, the borders of these high-intensity lesions conform to the shape of the surrounding sulci (see text).

The initial clinical presentation almost always includes seizures. Symptoms of increased intracranial pressure, meningitis or infarction can also be present. Results of a physical examination and cerebrospinal fluid evaluation are usually nonspecific. The diagnosis is made through the clinical history, serologic studies, imaging procedures and biopsy.[1]

The plain film, angiographic and CT findings of cysticercosis have been well described.[2-8] Before the advent of magnetic resonance imaging, CT was felt to be the diagnostic modality of choice.[1] CT findings include punctate calcifications, ring-enhancing cysts, ill-defined lucencies and round or oval homogeneously enhancing lesions. Calcifications are more commonly seen in adults, while diffusely enhancing lesions are more common in children.

MR was extremely valuable in evaluating cysticercosis in our two patients. Because of its higher sensitivity to increased water content, we feel that MR is more sensitive than CT in detecting the cystic lesions surrounded by edema. Indeed, in our first case, many more lesions were noted on MR images than on CT scans. The punctate areas of decreased intensity noted within the high-intensity signal most likely represent the scolex of the larva.[9]

Interestingly, in our second case, the cystic central area apparent on CT scan (Figure 5, left) is seen on MR images as an area of signal intensity similar to normal gray matter and much less intense than cerebrospinal fluid on the T2-weighted image (Figure 5, middle). This could possibly be due to a higher protein content within the cyst, facilitating spin-spin relaxation by the enclosed water molecules and thereby shortening the T2.[10] Perhaps the shorter T2 of these cysts will be a consistent finding that will increase the radiographic specificity of this diagnosis. (T1 and T2 are the spin-lattice and spin-spin relaxation times, respectively,

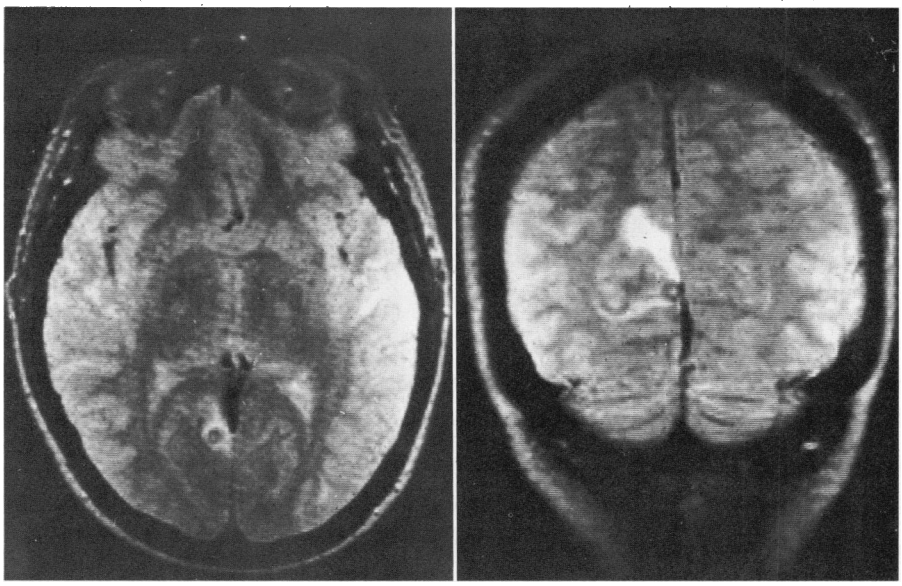

Figure 3.—Patient 1. **Left,** Axial (repetition time [TR] 2,000 ms, echo-delay time [TE] 80 ms) and **right,** coronal (TR 2,233 ms, TE 80 ms) spin-echo images through an occipital lesion. Note the focal spherical low-intensity area inferiorly within the high-intensity lesion in both images; this is felt to represent the scolex.

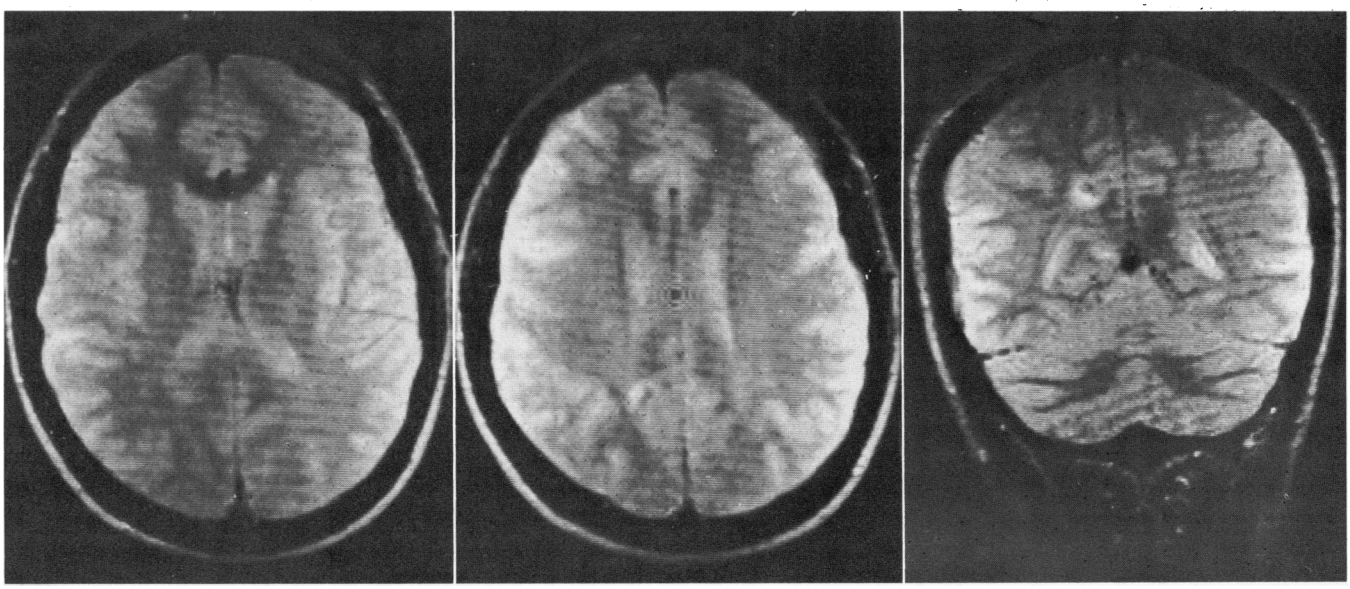

Figure 4.—Patient 1. Follow-up magnetic resonance images three weeks after beginning therapy with praziquantel. There has been pronounced resolution of the edematous regions within the cerebral hemispheres. The central low density **(right** and **middle)** is a machine artifact and not a lesion.

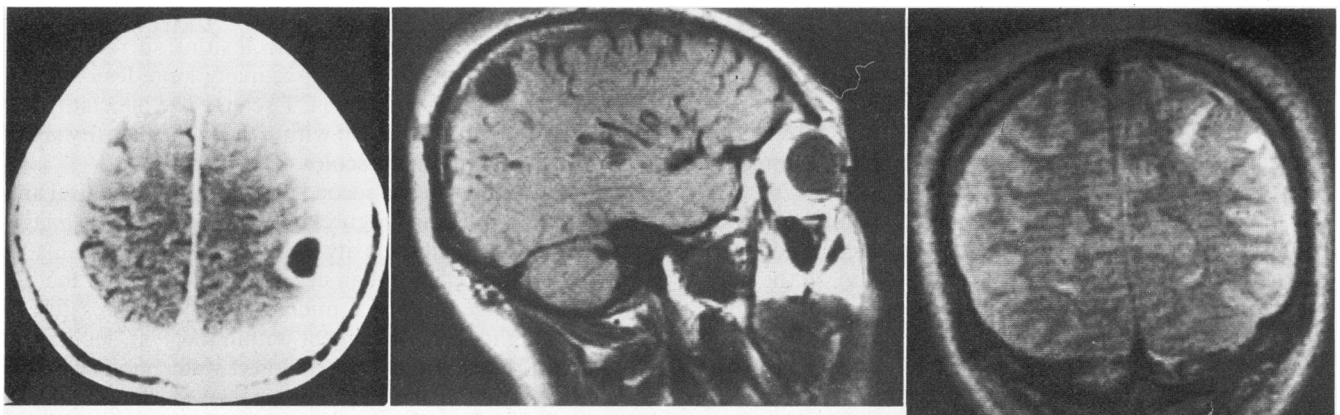

Figure 5.—Patient 2. **Left,** A rim-enhancing, rounded lesion is seen in the left parietal convexity on this contrast-enhanced computed tomographic scan. **Middle,** Sagittal (repetition time [TR] 850 ms, echo-delay time [TE] 40 ms) and, **right,** coronal (TR 2,000 ms, TE 80 ms) spin-echo images of the cysticercal cyst show a long T1 and medium-length T2, with the surrounding high intensity on the coronal scan probably representing edema. Effacement of the surrounding sulci is better shown on the T1-weighted image **(middle)**, while effacement of the normal surrounding white matter shows better on the T2-weighted coronal scan **(right)**.

for a nucleus in a magnetic field. They measure how quickly the nuclei return to their ground state energy level after excitation by a radio-frequency pulse. A short T1 relaxation time and a long T2 relaxation time are associated with high signal intensity on spin-echo sequences.[11])

The differential diagnosis in a patient with many long T1 and long T2 lesions in the brain includes multiple infarction (bland or septic), encephalitis subcorticalis chronica (Binswanger's disease), demyelinating disease and some metastases, as well as cysticercosis. The largely gray matter-subarachnoid space location of the lesions in our case would eliminate Binswanger's and demyelinating disease, and the clinical presentation should separate metastases and multiple infarcts from the presence of cysticercosis. Additionally, none of the above-mentioned diseases should present with a central, punctate, low-intensity focus.

Another feature that may be important in the lesions observed in our first case is their shape. As mentioned earlier, cysticerci tend to conform to the shape of the space they occupy when they are intraventricular or in the subarachnoid space. In case 1, the borders of the lesion tend to conform to those of the surrounding sulci. Unfortunately, no strongly T2-weighted imaging was done and, with the available images, it is not possible to separate cyst from surrounding edema. Possibly no cyst was present in these lesions, as none was seen on CT. If this is the case, we are probably just seeing edematous parenchyma. In future cases, additional spin-echo sequences will be used in an attempt to identify the cyst itself and determine its shape and T1 characteristics.

In our first case, follow-up MR imaging showed almost complete resolution of the lesions one month following therapy (Figure 4). Thus, another potential use for MR, especially in cases where the diagnosis is not completely firm, is to assure that appropriate response occurs following therapy.

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Hemophilus influenzae Pericarditis in Two Adults

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SERIOUS INFECTIONS caused by *Hemophilus influenzae* type b commonly occur during childhood. *H influenzae* has been recognized with increasing frequency in adults as a cause of

(Weingarten S, Weinberg H, Fang M, et al: *Hemophilus influenzae* pericarditis in two adults. West J Med 1986 Nov; 145:690-694)

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